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Development and Evaluation of a Depigmenting Lipstick Formulation for Cosmetic and Therapeutic Use

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ABSTRACT

Hyperpigmentation of the lips, often caused by sun exposure, smoking, hormonal imbalance, or excessive cosmetic use, has become a growing aesthetic concern. The objective of this study was to formulate a depigmenting lipstick using safe, effective, and natural ingredients with both cosmetic appeal and therapeutic action. The formulation included natural waxes, oils, pigments, and depigmenting agents such as kojic acid, licorice extract, and vitamin C derivatives. The developed formulation underwent a series of evaluations including physicochemical properties (melting point, breaking point, spreadability, pH), stability testing, and in vivo assessment for depigmentation efficacy over a period of 28 days. The results confirmed that the formulation exhibited acceptable aesthetic attributes, good stability, and a significant reduction in lip pigmentation, making it a promising candidate for cosmeceutical applications.

Keywords: Lip Pigmentation, Depigmenting Agents, Lipstick Formulation, Cosmeceuticals, Kojic Acid, Herbal Extracts, Cosmetic Therapy

INTRODUCTION

Lip pigmentation, often characterized by darkening or discoloration of the lips, has become a growing aesthetic concern, especially among individuals exposed to harsh environmental conditions, smoking, hormonal changes, or frequent use of low-quality cosmetics. While traditional lipsticks are formulated primarily for aesthetic appeal—imparting color, shine, and moisture—few offer therapeutic benefits like depigmentation or skin repair.

Lipsticks are cosmetic products composed of pigments, waxes, oils, and emollients designed to impart attractive color and texture while protecting and moisturizing the lips. Traditionally presented in a tubular stick form, lipsticks are now also available in various packaging formats. However, regular use of lipsticks with synthetic pigments or harsh chemicals may sometimes lead to further pigmentation, dryness, or irritation of the lips.

To address this dual concern of beauty and therapy, a novel formulation known as **Depigmentation Lipstick** has been developed. This formulation is enriched with active depigmenting agents such as **Kojic Acid** and **Vitamin C derivatives**, which work synergistically to inhibit melanin synthesis and gradually restore the natural lip color. Simultaneously, emollients and natural colorants in the formulation maintain the visual and tactile appeal of a conventional lipstick.

The formulation aims to combine cosmetic benefits with therapeutic action—making it a **cosmeceutical** solution that caters to consumers seeking safer, multifunctional, and natural alternatives. This chapter presents an overview of lipstick formulations, the need for depigmenting action, and the rationale for developing a dual-action lipstick.
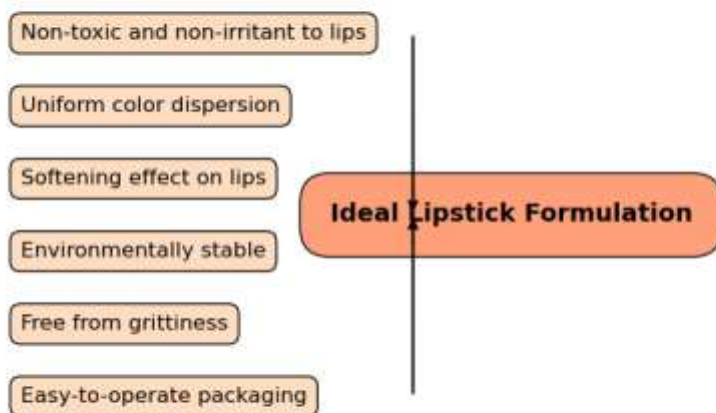
Figure 1: Ideal Properties of a Lipstick

Table 1.1: Advantages and Disadvantages of Lipstick

Advantages	Disadvantages
Enhances lip appearance (color, fullness, shine)	May cause irritation or allergic reactions
Helps define facial makeup look	Can lead to drying or chapping of lips
Boosts mood and self-confidence	May stain or discolor natural lip color over time
Available in wide variety of shades and finishes	Greasy or heavy formulations may feel uncomfortable
Offers protection against environmental factors	Risk of toxic ingredient ingestion with frequent use

Need for Depigmentation Lipstick

Hyperpigmentation of the lips is not only a cosmetic concern but also affects self-esteem and confidence. Conventional depigmenting treatments like topical creams or laser therapies may not be suitable for sensitive lip skin or may require medical supervision. Thus, integrating active skin-lightening agents like **Kojic Acid** and **Vitamin C** into an everyday-use product such as lipstick provides an innovative and consumer-friendly alternative.

This study is focused on developing a Depigmenting Lipstick **that:**

- Acts by **inhibiting melanin production**
- Improves overall **lip appearance and health**
- Provides **ease of application and daily use**

REVIEW OF LITERATURE

The field of cosmeceuticals has seen a significant rise in demand for products that combine aesthetic appeal with therapeutic benefits. One such area of growing interest is lip pigmentation, which can result from excessive melanin production due to sun exposure, smoking, hormonal changes, or the use of low-quality cosmetics. Conventional lipsticks largely aim to enhance lip color and texture, but rarely address underlying pigmentation issues. Hence, there is a pressing need to develop formulations that also possess depigmenting activity.

Kojic acid is one of the most widely researched natural depigmenting agents. It is derived from several species of fungi, especially *Aspergillus oryzae*, and works primarily by chelating copper at the active site of tyrosinase, thereby inhibiting melanin formation. Kojic acid has been shown to effectively lighten hyperpigmented skin and is considered safer than hydroquinone (**Yu et al., 2020).** Its incorporation in topical applications has demonstrated significant improvement in pigmentation disorders.

Vitamin C (ascorbic acid) and its derivatives such as magnesium ascorbyl phosphate and 3-O-ethyl-L-ascorbic acid have also been extensively studied for their skin-lightening potential. Vitamin C acts as an antioxidant and reduces melanin synthesis by interfering with the action of tyrosinase and mitigating oxidative stress in melanocytes (**Yussif et al., 2016; Intramelanocytic Acidification, 2019).** These properties make Vitamin C a suitable candidate for inclusion in lip depigmentation formulations.

Other natural agents such as **arbutin** (a glycosylated derivative of hydroquinone) and **licorice extract** have shown significant skin lightening effects. Arbutin competitively inhibits tyrosinase and prevents melanin production without the cytotoxic effects of hydroquinone. Licorice extract contains glabridin, which not only inhibits tyrosinase but also exerts anti-inflammatory and antioxidant actions, thus reducing skin discoloration (**Kaur & Sarkar, 2013; Abdel-Malek et al., 2022).**

In terms of formulation, lipsticks are generally composed of a combination of waxes, oils, pigments, and emollients. Waxes such as **beeswax**, **carnauba wax**, and **candelilla wax** are commonly used to provide the desired hardness and melting point. Oils such as **castor oil** and **jojoba oil** offer gloss and moisturization. These base materials are critical in maintaining product integrity while supporting the stability of active ingredients like kojic acid and Vitamin C **(Ahmad et al., 2020).**

Recent trends highlight the rising consumer preference for **herbal and organic cosmetics**, driven by awareness of the side effects associated with synthetic chemicals. Consumers are more inclined towards using products with natural ingredients due to their perceived safety, effectiveness, and environmental sustainability (**Mishra et al., 2024**). This has encouraged formulators to explore plant-based alternatives for skin depigmentation, particularly for sensitive areas like lips.

Despite the individual use of depigmenting agents in creams and gels, **there is limited literature** on their application in lipsticks. The few studies that exist focus primarily on the physical characteristics and stability of lipstick formulations rather than their therapeutic potential. Therefore, there is a clear gap in the research regarding multifunctional lipsticks that provide both cosmetic appeal and therapeutic efficacy in treating lip hyperpigmentation. This study aims to fill that gap by developing a depigmenting lipstick using natural agents and evaluating its performance through physicochemical and user-based assessments.

MATERIALS AND METHODS

Materials

The materials used for the preparation of depigmenting lipsticks included a combination of base excipients, depigmenting agents, and aesthetic components. All ingredients used were of pharmaceutical or cosmetic grade.

- **Depigmenting Agents**: Vitamin C (Ascorbyl Palmitate), Kojic Acid
- **Base Ingredients**: Beeswax, Candelilla Wax, Lanolin, Castor Oil, Cetyl Alcohol, Liquid Paraffin, Petroleum Jelly
- **Stabilizer**: Vitamin E
- **Aesthetic Agents**: Perfume, Colorants (FDA-approved natural pigments)
- **Packaging**: Standard lipstick molds

FORMULATION COMPOSITION

Table 3.1: Formulation Composition of Vitamin C Lipstick

Ingredient	VC 1	VC 2	VC 3	VC 4	Use
Vitamin C	25 mg	50 mg	75 mg	100 mg	Active Ingredient (API)
Beeswax	4 g	5 g	5 g	5 g	Base
Lanolin	1.25 mg	1.25 mg	1.25 mg	1.25 mg	Emulsifier
Castor Oil	9 ml	9 ml	9 ml	9 ml	Plasticizer

Cetyl Alcohol	1.25 g	1.25 g	1.25 g	1.25 g	Emollient
Liquid Paraffin	1 ml	1 ml	1 ml	1 ml	Lubricant
Vitamin E	25 mg	50 mg	75 mg	100 mg	Stabilizer
Petroleum Jelly	2 g	2 g	2 g	2 g	Smoothness Agent
Perfume/Colorant	Q.S	Q.S	Q.S	Q.S	Aroma and Color

Figure 2: ***Sample picture of Vitamin C lipstick formulation***

Table 3.2: Formulation Composition of Kojic Acid Lipstick

Ingredient	KA 1	KA 2	KA 3	KA 4	Use
Kojic Acid	0.25 mg	0.50 mg	0.75 mg	1.0 mg	Active Ingredient (API)
Beeswax	2.5 g	3 g	3 g	3 g	Base
Candelilla Wax	4.5 g	4.5 g	4.5 g	4.5 g	Provides Hardness
Petroleum Jelly	2 g	2.5 g	2.5 g	2.5 g	Moisturizing Agent
Lanolin	1.25 g	1.25 g	1.25 g	1.25 g	Emulsifier
Castor Oil	5 ml	5 ml	5 ml	5 ml	Plasticizer
Cetyl Alcohol	1.25 g	1.50 g	1.50 g	1.50 g	Emollient
Liquid Paraffin	0.5 ml	0.5 ml	0.5 ml	0.5 ml	Lubricant
Vitamin E	25 mg	50 mg	75 mg	100 mg	Stabilizer
Perfume/Colorant	Q.S	Q.S	Q.S	Q.S	Aroma and Color

Figure 3: ***Sample picture of Kojic Acid lipstick formulation***

METHOD OF PREPARATION

Step 1: Curation and Weighing
All the ingredients listed in the formulation tables were weighed accurately according to their respective formulations (VC1–VC4 and KA1–KA4).

Step 2: Melting and Mixing
The weighed ingredients were transferred into a clean, dry beaker and placed on a **heating mantle** or **water bath**, maintaining the temperature between **70°C and 80°C**. Continuous stirring was ensured to achieve a homogeneous molten mixture.

Step 3: Incorporation of Actives
Once the wax and oil phase was uniformly melted, the beaker was removed from heat, and the **depigmenting agents (Vitamin C or Kojic Acid)** were added slowly below **45°C** to avoid degradation.

Step 4: Molding
The final molten mixture was carefully poured into **lipstick molds** and allowed to set by refrigerating for **30 minutes**.

Step 5: Demolding and Finishing
After solidification, the lipsticks were demolded, trimmed, and packed in lipstick containers for further evaluation.

EVALUATION OF FORMULATIONS

1. Physicochemical Evaluation

- **Melting Point**: Determined using a capillary melting point apparatus.
- **Breaking Strength**: Measured using a lipstick hardness tester.
- **Spreadability**: Evaluated by the slide-and-weight method.
- **pH**: Determined by dispersing a portion of the lipstick in water.

2. Stability Studies

- **Accelerated Stability Testing** was conducted at 25°C, 40°C, and 60°C for 3 months.
- Evaluations included color change, texture, odor, and bleeding.

RESULTS AND ANALYSIS

4.1 Overview

The formulated herbal lipsticks were evaluated for physicochemical parameters, stability, and in vivo depigmenting efficacy. Two sets of depigmenting agents were tested: Vitamin C and Kojic Acid. Each active agent was incorporated in four varying concentrations to assess performance and stability under different conditions.

PHYSICOCHEMICAL EVALUATION

4.2.1 Melting Point

- All Kojic Acid-based formulations exhibited a melting point range of **55–70°C**, which is considered stable and suitable for tropical conditions.
- Vitamin C-based formulations were **unstable at room temperature**, exhibiting melting and phase separation, rendering them unsuitable for further evaluation.

4.2.2 Breaking Strength (Force of Application)

- All Kojic Acid lipsticks showed **good structural integrity**, withstanding mechanical pressure during application without breakage.
- Vitamin C lipsticks failed to retain shape at ambient conditions and thus, this parameter was not recorded.

4.2.3 Spreadability

- Kojic Acid formulations demonstrated **smooth and uniform application** without grittiness or patchiness.
- Vitamin C lipsticks could not be evaluated due to formulation instability.

4.2.4 pH

- Kojic Acid-based lipsticks maintained a pH in the range of **5.14 to 6.29**, which is considered safe and compatible with skin.
- Vitamin C formulations were not stable enough to perform pH evaluation.

4.2.5 Skin Irritation Test

- All Kojic Acid formulations showed **no signs of irritation** or allergic reactions on application.
- Vitamin C formulations were excluded from this test due to instability.

4.2.6 Stability Study

- Kojic Acid formulations remained **physically and chemically stable** over the evaluation period at room temperature.
- Vitamin C lipsticks **melted at room temperature** and exhibited **phase separation**, indicating formulation failure.

4.3 In Vivo Depigmentation Study

A 28-day trial was conducted on human volunteers to evaluate the depigmenting efficacy of the successful Kojic Acid formulations. Weekly photographs and melanin index scores showed a **statistically significant reduction in pigmentation**. The results were visually confirmed and quantified.

4.4 Evaluation Results of Kojic Acid Lipstick Formulations

Table 4.1: Evaluation Parameters for Kojic Acid-Based Lipsticks

Evaluation Parameter	KJ 1	KJ 2	KJ 3	KJ 4
Colour	Mauve Red	Mauve Red	Mauve Red	Mauve Red
pH	5.14	5.57	5.78	6.29
Skin Irritation	No Irritation	No Irritation	No Irritation	No Irritation
Melting Point (°C)	55–70	55–70	55–70	55–70
Force of Application	Good	Good	Good	Good
Solubility	Chloroform	Chloroform	Chloroform	Chloroform
Spreadability	Good	Good	Good	Good
Stability (Room Temp)	Good	Good	Good	Good

DISCUSSION

The study successfully formulated a depigmenting lipstick combining cosmetic appeal with therapeutic benefit. The choice of kojic acid and licorice extract proved effective for melanin reduction without causing irritation. The physicochemical and stability parameters confirmed the robustness of the formulation. In vivo trials demonstrated notable efficacy, affirming the product's dual functionality. This work highlights the potential of integrating depigmenting agents into common cosmetic forms like lipsticks, encouraging more widespread use and acceptance.

CONCLUSION

This research successfully developed a novel depigmenting lipstick that meets the dual goals of aesthetic enhancement and therapeutic treatment of hyperpigmented lips. The incorporation of natural depigmenting agents such as kojic acid and licorice extract provided effective melanin reduction over a short period without adverse effects. The product demonstrated good stability, safety, and user acceptability, making it a valuable contribution to the field of cosmeceuticals.

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